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16. Abstract (Limit: 200 words)

This document contains up-to-date chemical information, including a summary of the Agency's regulatory position and rationale, on a specific pesticide or group of pesticides. A Fact Sheet is issued after one of the the following actions has occurred.

1. Issuance or reissuance of a registration standard,
2. Issuance of each special review document,
3. Registration of a significantly changed use pattern,
4. Registration of a new chemical, or
5. An immediate need for information to resolve controversial issues relating to a specific chemical or use pattern.

17. Document Analysis a. Descriptors

Pesticides, regulations, Chemical Information Fact Sheet, Use Patterns, science findings.

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

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Pesticide Fact Sheet

Name of Chemical: Tributyltin
Reason for Issuance: Preliminary Determination
Date Issued: October 1, 1987
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1. Description of chemicals

Chemical Name	Common Name	Chemical Abstract Service Number	EPA Shaughnessy Code
bis(tributyltin) adipate	none	7437-35-6	083117
bis(tributyltin) dodecenyl succinate	none	12379-54-3	083101
bis(tributyltin) oxide	TBTO	56-35-9	083001
bis(tributyltin) sulfide	none	4804-30-4	083113
tributyltin acetate	none	56-36-0	083105
tributyltin acrylate	none	13331-52-7	083121
tributyltin fluoride	TBTF	1983-10-4	083112
tributyltin meth-acrylate and copolymer	TBTM TBTM	2155-70-6, 26345-187	083120 083119
tributyltin resinate	none	none assigned	083114

Chemical family: Organotins

Pesticide type: biocide, antifoulant, and disinfectant. The Special Review is being conducted for the use of these chemicals in antifoulant paint registrations. Twenty TBT compounds are registered as pesticidal active ingredients and nine of the compounds are registered for use in antifouling paints. The major TBT pesticide is tributyltin oxide.

Registrations: Antifoulant paints containing tributyltin (TBT) compounds were initially registered in the early 1960's. At the initiation of the Special Review there were 364 TBT antifouling paint formulations and 20 formulating intermediates with a total of 61 manufacturers. Since January, 1986, 162 products have been voluntarily cancelled and some companies have merged such that there are now 210 registered antifouling paint formulations and 12 formulating intermediates with 34 manufacturers, although nearly half of the paint formulations have been suspended for non-compliance with a Data Call In Notice issued in July, 1986.

2. Use patterns and formulations

Application sites: TBT's are used in antifoulant paints applied to ship and boat hulls as well as buoys, crab pots, fish nets, etc. TBT's are also registered as wood preservatives, disinfectants, and biocides for use in cooling towers, pulp and paper mills, breweries, leather processing facilities, and textile mills.

Paint formulations: TBT antifouling paints may be classified into three categories according to the way the TBT moiety is incorporated into the paint coating and subsequently released.

- Free association paints: In these conventional coatings the TBT is physically incorporated into the paint matrix (which contains the pigment, water-soluble resins, and inert substances). The TBT leaches from the paint surface by diffusion. Gradually, the paint matrix becomes clogged with insoluble materials trapping some of the toxicant while leaving the surface unprotected.

- Copolymer paints: In this category the TBT moiety is chemically bonded to a polymer matrix. The biocide is released only by chemical hydrolysis of the TBT itself. These paints are characterized by slow dissolution from ship hulls and thus achieve a constant but prolonged, release of antifoulant toxicant.

- Ablative paint: These paints have characteristics of both of the other two types of paint. The TBT is not bound to a polymer, but is incorporated into the paint matrix. Ablative paints are soft paint films with the rosin portion of the paint slightly water soluble so that the surface slowly sloughs or ablates away as the painted vessel moves through the water. This allows new toxicant layers to be exposed and prevents the buildup of insoluble materials.

A TBT antifouling paint formulation can have a single TBT active ingredient, can be combined with one or more of the other eight TBT antifoulants, can be combined alone with copper compounds (especially cuprous oxide), can be combined with triphenyltin fluoride (another organotin antifoulant), or can be combined with copper and other organotin compounds. Products are formulated with 0.5 to 41 percent active ingredient TBT. Application rates are commonly from 150 to 400 square feet per gallon of paint.

3. Science Findings

Chemical characteristics: Tributyltin compounds are chemically characterized by a tin (Sn) atom covalently bonded to three butyl (C_4H_9-) moieties. When released from the paint matrix or polymer into the aqueous environment, TBT exists mainly as a mixture of TBT hydroxide, TBT chloride, and TBT carbonate species from reaction with carbonates in seawater.

Environmental fate: The environmental chemistry and fate of tributyltin in aquatic environments are complex and not completely understood. Studies indicate that photolysis and microbial action are potential mechanisms of degradation from tri- to di- to monobutyltin and finally to inorganic tin. Studies indicate the half-life of TBT may be 116 days in aerobic soils, 815 days in anaerobic soils, 6 to 12 days in sea water, and up to 238 days in fresh water. TBT accumulates in sediment at levels that are one to four orders of magnitude greater than the concentration found in the respective water column. This amassing of toxicant can have serious consequences for organisms living and feeding in the benthos.

Low concentrations of elemental or inorganic forms of tin appear to cause negligible toxicological effects in man or wildlife. However, when carbon groups, such as butyl units, are added to the tin, there is an increase in fat solubility, ability to penetrate biological membranes, and consequently, toxicity. As the number of butyl groups is increased from one to three, there is a corresponding increase in lipophilicity and toxicity to aquatic organisms. However, the addition of a fourth butyl group decreases the toxicity of the molecule.

Ecological characteristics: The TBT compounds are toxic to aquatic organisms at the low parts per billion (ppb) level. A summary of aquatic TBT toxicity values are presented below:

° Fish

Acute Toxicity:	0.96 - 24.0 ppb
Chronic Toxicity:	> 0.2 ppb
Bioaccumulation:	200- to 4300-fold
Behavioral Toxicity:	Avoidance occurred at 1.0 to 24.0 ppb. Fish may not detect harmful sublethal levels.

° Bivalves

Acute Toxicity:	0.9 to 2.3 ppb
Chronic Toxicity:	0.02 to 0.05 ppb
Bioaccumulation:	2000- to 6000-fold
Bioavailable:	Yes, even with high silt loads.

° Gastropods

Acute Toxicity:	> 0.01 ppb
Chronic Toxicity:	0.002 to 0.02 ppb
Bioavailable:	Yes, was promoted as a molluscicide against schistosomiasis because it readily adsorbed to organic matter; snails preferentially ingest organic matter. (Lowest value is an extrapolation.)

° Crustaceans

Acute Toxicity:	0.42 to 2.2 ppb
Chronic Toxicity:	> 0.09 ppb
Bioaccumulation:	4400-fold
Bioavailable:	Yes, more from food than from water.
Behavioral Toxicity:	0.5 ppb caused positive phototaxis in daphnids.

° Algae

Acute and Chronic Toxicity:	growth inhibition at 0.1 to 0.35 ppb
Bioaccumulation:	800- to 30,000-fold
Bioavailable:	Yes, since filter feeders readily consume algae it can be assumed that phytoplankton laden with TBT can be consummed by aquatic organisms.

TBT concentrations are reported to be highest in areas of heavy boating and shipping activity. Before recoating, old paint containing the remaining TBT residue is scraped from the vessel hull and sometimes the scrapings are washed into the water adjacent the boat or shipyard (despite TBT labels prohibiting this practice). TBT has been measured in marine and fresh water environments at levels indicated below. Note that ND means non-detectable or below the level of detection of the analytical method used.

Chesapeake Bay:	ND to 0.8 ppb
San Diego Bay:	ND to 1.0 ppb
San Francisco Bay:	ND to 0.16 ppb
Honolulu Harbor	0.045 to 0.27 ppb
Los Angeles/ Long Beach Harbor:	ND to 0.12 ppb
Narragansett Bay:	ND to 0.13 ppb
Thames River (CT):	ND to 0.009 ppb
Mayport Florida:	ND to 0.016 ppb
Lake Superior:	0.02 ppb
Lake Ontario:	0.05 to 0.84 ppb

Population Effects: In France, a correlation has been found between TBT in the water column of certain estuaries and gross malformations in Pacific oysters grown in commercial oyster beds in and around areas of heavy boating activity. Following a ban on TBT antifouling paints on vessels less than 25 meters in length, the degree of shell deformities has decreased and the regeneration rate of juvenile oysters (spat) has improved. In England TBT has been reported causing similar shell deformities in Pacific oysters and reproductive abnormalities (imposex) in dogwelk snails. The Department of Fish and Wildlife of Oregon recently have found shell deformities in commercial Pacific oyster beds in Coos Bay which are near a small shipyard applying and removing TBT antifouling paints.

4. TBT Release Rates

The Tributyltin Data Call In Notice (TBT DCI) required all registrants of TBT antifouling paints to measure TBT release from registered paints following a test method developed in cooperation with the American Society for Testing and Materials (ASTM). In addition, each laboratory conducting the TBT release test was required to test a standard copolymer test paint.

Release rate data were submitted for 96 TBT antifouling paint products by July 1, 1987. From a review of these data, it was determined that at least 57 of the tests were conducted satisfactorily and all data were normalized according to adjustments made using the standard test paint results. Two release rate

values were determined for each product: 1) a short term cumulative release measured over the first 14 days of the test period and 2) an average daily release rate (average of the daily release over weeks 3 to 5 of the test). Details of release rate data are available in the Tributyltin Technical Support Document.

Generally, the release rates start high (short term cumulative release ranged from 1 to 1128 ug/cm^2) and gradually decrease over the course of the test period (average daily release rate ranged from 0.02 to 21.53 ug/cm^2/day). Some paints with a high percentage of TBT have a much higher short term cumulative release than do other paints tested. It was concluded that while there was a strong statistical correlation between the percent active ingredient and the average daily release rate, the data points were too scattered for the percent active ingredient alone to be useful for regulating TBT paints. The scattered data points indicated that other factors, such as the type and quality of the inert ingredients (resins, rosins, binders, etc.) may be important in determining the release rate of a paint and that regulating on percent active ingredient would not necessarily reduce environmental loading.

Results of the release rate tests also showed that some TBT ablative and free association paints have lower release rates than many copolymer paints. The free association paints with release rates lower than copolymer paints generally had a low percentage of TBT in their formulations.

5. Summary of regulatory position and rationale

The Agency initiated a Special Review of TBT products used as antifoulants in January, 1986, based on concern of possible adverse effects of TBT to nontarget aquatic organisms. The Agency recognized that additional data were required and issued a Data Call In Notice (DCI) for TBT products registered for use as antifoulants or registered as formulating intermediates used to produce antifoulant products. The DCI required information on product chemistry data, TBT release rate data, usage data, worker exposure data, ecological effects data, and environmental fate data. The DCI also required submission of any available efficacy data. For many products, product chemistry data, TBT release rate data, and usage data have been received. Although the Agency will not have the ecological and environmental fate data from the DCI for another one to four years, the Agency believes sufficient data are available to propose a set of regulatory actions. In 1985, the Agency issued a DCI on tributyltin oxide requiring data on chronic toxicity to mammals. These data are not due into the Agency until 1990.

The Agency examined a range of regulatory options to reduce TBT loading into the environment. The Agency considered: 1) cancelling all TBT antifouling paint registrations, 2) proposing a restriction on the maximum permitted percent TBT active ingredient in registered products, 3) regulating the type of paint formulation, 4) regulating the release rate, 5) restricting the size of vessel treated, and 6) classifying TBT antifouling paints as restricted use pesticides and requiring additional wording on the label giving directions concerning application, removal, and disposal of TBT paints to reduce the amount of TBT entering the aquatic environment from these activities.

The Agency is proposing continued registration of TBT antifouling paint products with certain regulatory restrictions: 1) limit the maximum organotin release rate from paint formulations, 2) prohibit use of TBT on non-aluminum vessels under 65 feet in length, and 3) classify TBT antifouling paints as restricted use pesticides and require additional wording on the label regarding application, removal, and disposal of TBT paints to prevent introduction of TBT paint wastes into the aquatic environment. Specifically, the Agency is proposing a maximum short term cumulative release (days 1 to 14 of test period) of 168 ug organotin (calculated as TBT cation)/cm^2 and an average daily release rate (averaged over weeks 3 to 5 of the test) of 4.0 ug organotin (calculated as TBT cation)/cm^2/day. The Agency believes that the proposed release rate restrictions would reduce loading five-fold from its estimated average daily release rate of 20 ug/cm^2/day before initiation of the Special Review (calculated for all TBT paint formulations from the submitted release rate data). The prohibition of use on vessels under 65 feet should reduce by 37 percent (the estimated volume of TBT paint used on this size class by a boat and shipyard survey) the total amount of TBT antifoulant currently used and potentially available for environmental contamination. This limitation in use will result in a reduction in TBT concentration primarily in estuarine and fresh water areas where these small vessels are used and moored and where the risk from TBT effects is the greatest. The restricted use classification and additional wording on the label regarding size restriction and directions for applying, removing, and disposing of TBT paints without introducing paint wastes into the water will help ensure that TBT paints are not used on vessels under 65 feet and that TBT paints will be applied and disposed in a manner which will reduce the risk of inadvertent aquatic contamination. Monitoring and efficacy data will be required separately which will be used to evaluate the effectiveness of these proposals.

Upon receipt and evaluation of additional data, the Agency may determine that further regulatory action is warranted.

6. Contact person at EPA

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